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(71)(72) Applicants and Inventors: KAUHANIEMI, Jari [FI/FI]; Näätäkuja 3 C 25, FIN-01480 Vantaa (FI). KAUHANIEMI, Petri [FI/FI]; Rysäkatu 21 C 7, FIN-20900 Turku (FI).

(74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).

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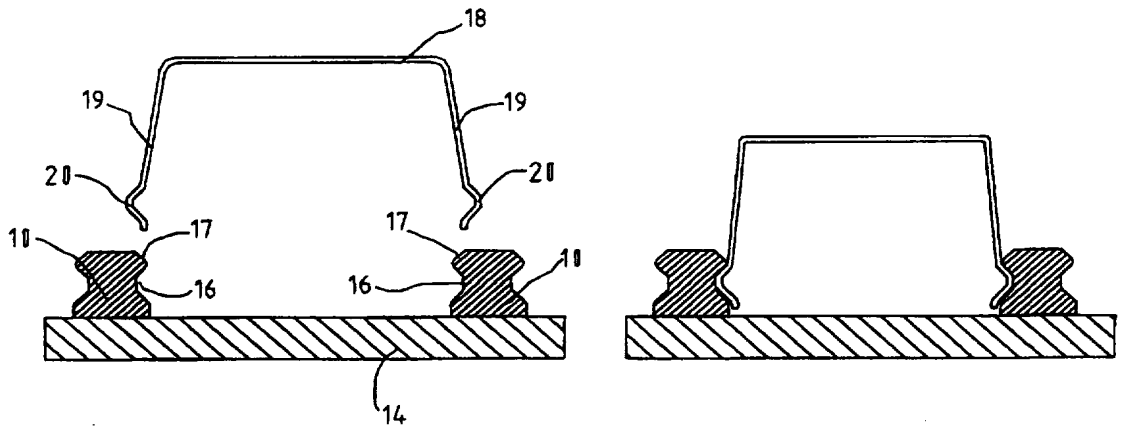

4a 4b

(57) Abstract

A surface-mounted attachment means (10) having a contact part (11) for the seizing head of an insertion machine for surface-mounted components, a joining surface (13) for attachment to a printed circuit board, and a preformed point of attachment, which may be a groove (16; 26) or protrusion (21), is used for attaching an EMC shield (18) and other mechanical components to a printed circuit board (14) and for attaching the printed circuit board to other mechanical parts. The EMC shield has an elastic side wall (19) and, therein, a corresponding preformed part (20) which, during installation, is pushed by a spring force caused by the elastic side wall against a locking groove or protrusion in the attachment means and holds the EMC shield in its place. Other mechanical attachments (23), too, can be implemented by means of a similar attachment means.

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Surface-mounted attachment means and use thereof

The invention relates in general to the attachment of mechanical components to printed circuit boards and in particular to attachment means which can be surface-mounted onto a printed circuit board and to which mechanical components, such as EMC shields, can be later fitted. The invention also relates to the EMC shield the attachment of which is based on the use of said attachment means.

EMC (electromagnetic compatibility) shielding, or shielding of electronic components against electromagnetic interference, plays an important role in the attempt to secure reliable operation of electrical apparatuses. Many apparatuses employ shields made of an electrically conductive material attached to a printed circuit board so as to cover certain components. Generally the printed circuit board has other mechanical points of attachment as well.

The simplest method of arranging the attachment of a shield or other mechanical attachment is to bore a hole in the printed circuit board and fasten the mechanical component in question to the hole using a screw or a wedge-shaped pin. The pin penetrating the printed circuit board can also be soldered to a metal strip on the surface of the printed circuit board, thereby providing a contact with the ground potential or other desired potential. Several attachment arrangements developed especially for EMC shields are known in the prior art. For example, U.S. Patent No. 4 754 101 discloses a frame made of a thin plate according to Fig. 1, having several attachment pins on a lower edge and several deflectable engagement prongs on an upper edge. The attachment pins are soldered to holes in the printed circuit board and an EMC cover is pushed against the engagement prongs so that the spring force of the prongs holds the cover securely in its place. U.S. Patent No. 4 890 199 discloses a similar arrangement wherein the attachment frame comprises springs bent such that they have a U-shaped cross section, the bottom side of the U being soldered to a printed circuit board so that the ends of the U point upward. The edge of a cover plate is pushed between the upward-pointing ends so that the ends, or spring fingers, exert a force on the cover and hold it in place.

Patent document DE-31 28 856 discloses mechanical attachment means according to Fig. 2, suitable for attaching components having holes. The attachment means is a two-branch wedge pin pushed through a printed circuit board and a component from below so that a shoulder at the upper end of the two-branch pin prevents the pin

from falling off and the component from coming loose. Patent documents DE-24 54 957 and DE-24 57 228 disclose similar attachment means wherein the both ends of the means are two-branch wedge pins. The bottom wedge pin is fastened to a hole in a printed circuit board and the top wedge pin is fastened to a component having a hole so that shoulders at both ends prevent the attachment from coming loose.

Prior art arrangements based on pin attachment often have the disadvantage that holes in printed circuit boards use space in all layers of multi-layer printed circuit boards. Therefore it is desirable to have as few attachment pins as possible. On the other hand, if the attachment pins are wide apart, electromagnetic interference will leak through the gaps between the points of attachment of the EMC shield. A solution for this problem is provided by U.S. Patent No. 5 053 924, wherein springs are attached onto the edge of the cover in the areas between the attachment pins, such that the springs are pushed against a grounding strip on the surface of the printed circuit board. However, the manufacturing of the springs as separate mechanical components and their insertion comprise an extra stage in a process in which the number of stages typically has a considerable effect on the costs.

An alternative method is to solder or glue an integral EMC shield by its edges to a printed circuit board. The disadvantage of this method is that it is very difficult to service the components under the EMC cover.

It can be said that generally the prior art attachment arrangements for EMC shields are clumsy as far as automatization of production is concerned, since the attachment of shields has to be performed separately from the main assembly process which very often is a surface mounting process carried out by means of an insertion machine and a soldering furnace. As described above, holes through the printed circuit board are an unwanted factor as they require space.

An object of this invention is to provide attachment means enabling better mechanical attachment to a printed circuit board than what is achieved by prior art arrangements. Another object of the invention is to provide attachment means suitable to be used in the usual surface mounting process. A further object of the invention is to provide attachment means and a shield cover which can be attached using said attachment means and which can be repeatedly removed and reattached in an easy manner. A yet further object of the invention is that the attachment

arrangement according to the invention can be easily applied to a wide range of attachment needs.

The objects of the invention are achieved using an attachment piece having a contact surface to which the seizing head of an insertion machine for surface-mounted components can adhere, a joining surface to be adhered to a printed circuit board and a locking groove or shoulder to receive a counterpart in a mechanical component.

Attachment means according to the invention comprising a joining surface to be adhered to the surface of a printed circuit board is characterized in that it further comprises

- a contact part for providing temporary adherence between said attachment means and a seizing head intended to move said attachment means, and
- a preformed point of attachment to provide mechanical attachment between said attachment means and said component.

The invention is also directed to an EMC shield attached using the attachment means described above. The EMC shield according to the invention is characterized in that it has a deflectable side wall and it comprises a preformed point of attachment to provide mechanical attachment between said EMC shield and the attachment means fixed to a printed circuit board when said point of attachment and a preformed counterpart in said attachment means are engaged in a position which causes elastic deformation in said side wall and thereby a spring force pushing said point of attachment and said attachment means against each other.

The invention is based on the perception that by shaping a separate attachment piece in a carefully thought-out manner it can be adapted to meet all requirements set for a good attachment means. First, the attachment means must have a contact surface onto which an element of an insertion machine for surface-mounted components can firmly adhere so as to be able to place the attachment means precisely at the correct location on a printed circuit board. Second, the attachment means must have a joining surface whereby it can be attached to the surface of a printed circuit board without a hole in the printed circuit board. Third, the attachment means must have a preformed area corresponding to an area in the component to be attached so that when these counterparts are mutually engaged the component is held reliably in its place. If at least one of the counterparts is elastic or elastically attached, it is

possible to make use of the restoring capability of an elastic material according to which a body can be repeatedly removed and reattached.

In a preferred embodiment of the invention the attachment means is a relatively small mechanical element shaped such that it has all the aforementioned characteristics with the possible exception of elasticity. Small size is an advantage because using various numbers of attachment elements according to the invention and placing them in various formations it is possible to realize an almost limitless number of different attachments. Naturally the attachment means according to the invention can be made bigger or smaller according to the size of the component or shield attached and according to the extent to which the applier of the invention can affect the shape of the component or shield.

The EMC shield according to the invention has on its side wall a number of counterparts which may be projections or indentations and which correspond in their shape to a preformed area of the attachment means. The EMC shield is attached to its place in such a manner that the counterparts and the preformed parts of the attachment means fixed on the printed circuit board meet and become interlocked. In the preferred embodiment, the elasticity facilitating repeated removal and reattachment is a characteristic of the side wall of the EMC shield.

The following is a more detailed description of the invention with reference to the preferred embodiments presented by way of example and to the accompanying drawing in which

Fig. 1	illustrates an EMC shield attachment according to the prior art,
Fig. 2	illustrates a second prior-art EMC shield attachment,
Figs. 3a to 3c	illustrate a preferred embodiment of the attachment means according to the invention,
Fig. 3d	is an axonometric projection of the embodiment shown in Figs. 3a to 3c,
Figs. 4a and 4b	illustrate the EMC shield attachment according to an embodiment of the invention, and
Figs. 5a to 5i	illustrate other preferred embodiments of the invention.

Above, in connection with the description of the prior art, reference was made to Figs. 1 and 2, so below, in the description of the invention and its preferred embodi-

ments, reference will be made mainly to Figs. 3a to 5i. Like elements in the drawing are denoted by like reference designators.

Figs. 3a to 3c show in the form of a cross section a preferred embodiment of the attachment means according to the invention (Fig. 3a), its insertion (Fig. 3b) and attachment (Fig. 3c) to a printed circuit board. The attachment means 10 has in its upper part a contact surface 11 which is substantially a flat surface where the flat area is at least equal to the area of the corresponding surface in the smallest surface-mounted electronic components. That way, the seizing head 12 of the insertion machine for surface-mounted components can seize the attachment means in the same way as it seizes ordinary surface-mounted components, ie. by means of suction. At the lower part of the attachment means 10 there is a joining surface 13 which is substantially even. The attachment means can be soldered and/or glued by the whole joining surface or part of it to the corresponding area of a printed circuit board 14. If the attachment means 10 is designed to be attached through soldering, the printed circuit board 14 must have a plated area 15 reserved for this purpose. If the attachment means 10 is glued to the printed circuit board 14, plating for the attachment means is not needed. It is assumed in the embodiment shown in Figs. 3a to 3c that soldering is to be used, in which case, prior to the insertion of the attachment means, the plated area 15 is treated with soldering paste (not shown) in the same way as the printed circuit board areas to which electrical components are soldered.

Since a common insertion machine for surface-mounted components comprises a seizing head 12 the contact surface of which is parallel with the printed circuit board surface, it is advantageous that the contact surface 11 and joining surface 13 of the attachment means according to the invention are mutually parallel. The invention, however, does not demand it, as certain types of insertion machines can use seizing heads of different orientations. In some special cases it could be required that the attachment means according to the invention be fastened to an inclined surface, in which case the joining surface 13 must be beveled in the corresponding manner. If, instead of a suction head requiring a flat surface, the insertion machine has a gripper-type or other kind of seizing head, the flat contact surface 11 in the attachment means according to the invention can be replaced by another element enabling adherence.

In addition to the contact and joining surfaces described above the attachment means according to the invention comprises a preformed area intended to receive a

correspondingly preformed counterpart in the component to be attached. In the embodiment illustrated by Figs. 3a to 3c that preformed area comprises a locking groove 16. In the embodiment shown in the figures the groove is made symmetrically on both sides of the attachment means but it can also be manufactured on one side only. Symmetricity of the attachment means brings the extra advantage that if, during the mounting process, the attachment means is accidentally turned about its vertical axis by 180 degrees, it can still be successfully installed. The embodiment according to Figs. 3a to 3c also shows roundings 17 intended to facilitate the insertion of the component to be attached. Attachment of the component to the locking groove 16 and the function of the roundings 17 will be described later on.

Fig. 3d is an axonometric projection of the embodiment of the attachment means 10 according to Figs. 3a to 3c. The attachment means is here oblong in shape and the cross section shown in Figs. 3a to 3c is perpendicular to the longitudinal axis A. The joining surface, which in Fig. 3d faces down and is therefore not shown, is rectangular in shape. The attachment means according to the invention can also be manufactured as a rotationally symmetric piece or as a piece having an elliptic bottom (joining surface), in which case the cross section shown in Figs. 3a to 3c is a section on the plane of the symmetry axis of the rotationally symmetric piece or the vertical axis of the elliptic piece. However, the oblong shape according to Fig. 3d has the advantage that the preform of the attachment element can be an elongated tape which has a cross section like that shown in Figs. 3a to 3c and which the manufacturer or user cuts into suitably long attachment pieces according to need. The invention as such does not in any way limit the manufacturing method of the attachment means. Neither is the material of the attachment means essential as regards the invention. If the invention is applied to an attachment in which electrical conductivity plays no role, the attachment means may be composed of plastic, for example, in which case it is advantageously glued to the printed circuit board. In electrically conductive attachments, such as attachments of EMC shields, the attachment means is advantageously made of metal or an electrically conductive polymer, in which case it is soldered to the printed circuit board or glued to it using electrically conductive glue.

Figs. 4a and 4b show in the form of a cross section an EMC shield attachment according to a preferred embodiment of the invention. The printed circuit board 14 and the attachment means 10 are similar to those of the embodiment shown in Figs. 3a to 3c. The EMC shield 18 is made from a steel sheet 0.1 mm thick or from other known and electrically conductive material. The advantages of sheet steel include

good manageability, elasticity and a relatively low price. The downward-pointing sides 19, which connect to the horizontal cover plate of the shield 18, are shaped such that they have an outward-pointing bend 20 in their lower parts. The sides 19 may comprise a single whole or a number of adjacent strips. It should be noted that the words "downward" and "outward" and other such terms indicating direction only refer to the accompanying drawing and do not limit the use of the invention in different positions.

The EMC shield 18 is first lightly pushed against the attachment means 10 so that the roundings 17 guide the sides 19 so as to be deflected inward. As the shield 18 is pushed further toward the printed circuit board 14, the sides of the shield slide along the surface of the attachment means until the bend 20, shown on both sides of the cross section, snaps into the groove 16 in the attachment means. The locking groove and the bend forced against it comprise the counterparts to which reference was made earlier. The spring force caused by the deflection of the sides 19 pushes both sides 19 tightly against the facing attachment means 10 thereby providing a good electrical contact between the shield 18 and the printed circuit board 14 via the attachment means 10. Furthermore, the shield is held securely in its place as its movement up or down causes a force which attempts to restore the position shown in Fig. 4b as the beveled parts 20 and 16 slide against each other and deflect the sides 19. And if attachment elements are provided on all sides of a rectangular EMC shield, the shield cannot slide in the direction of the surface of the printed circuit board, either.

It is obvious to a person skilled in the art that the roundings 17 are not absolutely necessary, but they make the insertion of the EMC shield easier. Various designs, which differ in shape from the roundings 17 shown in the drawing but which are intended for the same purpose, are obvious variations of the embodiment of the invention described here. The designs may be directed to the attachment means or to the edge of the body to be attached or to both.

Figs. 5a to 5i show other design examples that illustrate the wide applicability and variability of the present invention. In the case shown in Fig. 5a the attachment means 10 has, instead of a locking groove, a locking shoulder 21, and the mechanical component to be attached has a corresponding groove 22. In Fig. 5b the attachment means 10 is similar to the one in Figs. 3a to 4b, but the sides 19 of the EMC shield comprise two branches 19a and 19b both of which have a bend directed against the attachment means. The bends directed towards each other are intended to

snap into the groove 16 of the attachment means from opposing sides. Fig. 5c very much resembles Figs. 4a and 4b, but the sides 19 of the EMC shield are dimensioned so as to become interlocked with the outer sides of the attachment means 10.

Fig. 5d shows a secure attachment in which the upper end of the attachment means 10 has a cross section shaped like T with downward-pointing seriphs at the ends of the horizontal stroke of the T. In the case depicted in Fig. 5d the mechanical component to be attached is a general-purpose fastening spring or lug 23 having two downward-oriented branches 24. Both branches include an upward-oriented locking tongue 25 on that side of the branch which is facing the attachment means 10. When the locking spring 23 is pushed against the attachment means 10 said branches 24, guided by roundings 17, are bent to the opposite sides of the attachment means until the locking tongues 25 slide over the horizontal arms of the attachment means and snap into the groove 26. Thanks to the T-shape of the upper part of the attachment means the groove 26 comprises on both sides of the attachment means locking hollows 27 into which the locking tongues 25 go. The locking hollow can also be described as an upside-down J with the curve of the J pointing away from the symmetry axis of the cross section of the attachment means.

In the attachment according to Fig. 5d, the fastening spring 23 will not become loose when pulled directly upwards as the locking tongues 25 then cannot slide off from the locking hollow 27. Disengagement is done by first pushing the fastening spring 23 toward the printed circuit board 14, forcing the branches 24 away from each other with a suitable tool, and then lifting the spring directly upwards, off of the attachment means 10. The secure attachment according to Fig. 5d is especially suitable for applications in which accidental disengagement of the component is particularly harmful. If, instead of a single fastening spring 23, the attachment is applied to a case or other body to be attached that has similar attachments on opposing sides, one of the branches 24 can be left out in the same way as in the embodiments shown in Figs. 4a, 4b, 5a and 5c.

Above it was assumed that the attachment piece according to the invention is made of a solid and relatively inelastic material and that the side wall of an EMC shield or other mechanical component attached to it is elastic. However, an embodiment according to Fig. 5e can be disclosed wherein the attachment means 10 is made of a preformed elastic metal sheet and the component 28 attached to it is made of a relatively inelastic material. It is presumed that the component 28 is attached to a

printed circuit board 14 by its opposing sides in the same way as the EMC shield in Figs. 4a, 4b, 5a and 5c, in which case the side need not have two branches. When the component 28 is pushed against the attachment means 10, the attachment means is deflected sideways until the bend in the side wall of the component 28 snaps into the locking groove 16. It should be noted that in Fig. 5e the joining surface 13 of the attachment means comprises two parts, so the invention does not require the joining surface to be continuous. The embodiment of Fig. 5e has, however, the disadvantage that when the component 28 is repeatedly removed and reattached, the elastic deformations of the attachment means 10 strain the juncture between it and the printed circuit board, which may cause the attachment means to come off of the printed circuit board.

The attachment means according to the invention may include more than the aforementioned one or two locking grooves or other preformed areas reserved for the counterparts in a component to be attached. Furthermore, in an embodiment in which there are two locking grooves or parts of grooves on opposing sides of the cross section, the grooves need not be located symmetrically with respect to the vertical axis of the cross section. Fig. 5f shows an embodiment of the invention wherein the attachment means according to the invention has a cross section taller than what is described above, comprising three pairs of locking grooves 16a, 16b and 16c. A mechanical component such as an EMC shield can be mounted at different heights on such an attachment means. One of the locking grooves, the lowest locking groove 16c, for example, may be a secure locking groove like the one described above, referring to Fig. 5d, so that an EMC shield which is meant to be removed more easily is not pushed all the way down but only as far as groove 16a or 16b. A component which is to be attached more securely is pushed all the way down so that its locking tongues snap into groove 16c. Fig. 5g further depicts an embodiment wherein the attachment means is not symmetrical with respect to the vertical axis of the cross section but a locking groove 16d on one side of the means is at a different height than a locking groove 16e on the other side. Then, one and the same attachment means can be used to attach components intended to be attached at different heights.

Fig. 5h shows two very simple cross section shapes for the attachment element according to the invention. On the left, the attachment means has a cross section shaped like a circle, in which case it may be round or oblong, ie. a piece of filament having a circular cross section. The top surface 11 of the attachment means is curved, not planar, but if a suitable seizing head (not shown) is used, this does not

impede the insertion of the attachment means in conjunction with the insertion of surface-mounted components. The attachment means is fastened to a printed circuit board 14 by means of solder or glue 30 and the joining surface 13 at the bottom part of the attachment means may be curved if only the attachment means according to the invention can be held in its place with sufficient precision until it is soldered to the board. The curved side surface 21 of the attachment means serves as a locking shoulder in the same way as the locking shoulder 21 in Fig. 5a. The attachment means shown on the right-hand side of Fig. 5h resembles the alternative on the left, but has a true elliptic cross section. Such an attachment means may comprise an ellipsoid or a piece of filament with an elliptic cross section. Since the circle is a special case of the ellipse, both cross sections in Fig. 5h can be called elliptic.

Fig. 5i shows, in axonometric projection, another embodiment of an attachment element according to the invention. In this case the cross-section of the elongated attachment element is hexagonal, thus clearly defining a flat contact surface and a flat joining surface parallel thereto, as well as locking shoulders on both sides of the attachment element. This embodiment is particularly advantageous because it may be turned around its longitudinal axis in steps of 60 degrees without changing its appearance or functionality. From the viewpoint of smooth operation in the assembly phase of an electronic device it is an advantage that the attachment element does not require that it should always have a one and only correct orientation.

It is obvious that all embodiments of the invention that have a locking groove or other corresponding design on both sides of the vertical axis of the cross section can be used to attach two adjacent EMC shields or other components. Then the bend or other corresponding design on the edge of a first component is pushed into the groove or other corresponding design on a first side of the attachment means and the bend or other corresponding design on the edge of a second component is pushed into the groove or other correspondind design on a second side of the attachment means.

The invention is a considerable improvement from the prior art because the attachment means according to the invention can be inserted and attached in the same process as the other surface-mounted components of a printed circuit board. The attachment means according to the invention does not require unreasonably precise tolerances during the manufacturing, nor the use of expensive special materials, and is therefore particularly suitable for series production. The EMC shield according to

the invention can be removed and attached repeatedly, easily and quickly. The invention uses space only on the surface of a printed circuit board, so it does not restrict the use of the other layers of a multi-layer printed circuit board.

Claims

1. Attachment means (10) for mechanically attaching a component (18; 23) to a printed circuit board (14), which attachment means comprises a joining surface (13) for adhering to the surface of the printed circuit board, **characterized** in that it also comprises

- a contact part (11) for creating a temporary attachment between said attachment means and a seizing head (12) intended to move it, and
- a preformed point of attachment (16; 21; 26) for creating a mechanical attachment between said attachment means and said component.

2. The attachment means of claim 1, **characterized** in that said joining surface is planar and said contact part is a planar contact surface (11) parallel to said joining surface (13).

3. The attachment means of claim 2, **characterized** in that said preformed point of attachment (16; 21; 26) is located between the plane defined by said joining surface and the plane defined by said contact surface.

4. The attachment means of claim 3, **characterized** in that said preformed point of attachment is a locking groove (16; 26) for creating a mechanical attachment between said attachment means and said component when said locking groove and a corresponding locking protrusion (20) in said component are placed against each other.

5. The attachment means of claim 4, **characterized** in that said locking groove comprises a first groove part (16; 16a) and a second groove part (16; 16a) which are located on opposing sides of the cross section of said attachment means.

6. The attachment means of claim 5, **characterized** in that the perpendicular distance of said first groove part from the plane defined by said joining surface equals the perpendicular distance of said second groove part from the plane defined by said joining surface.

7. The attachment means of claim 5, **characterized** in that the perpendicular distance of said first groove part (16d) from the plane defined by said joining surface is unequal to the perpendicular distance of said second groove part (16e) from the plane defined by said joining surface.

8. The attachment means of claim 5, **characterized** in that it further comprises a third groove part (16b) and a fourth groove part (16b), said third groove part being located on the same side as said first groove part in such a manner that the perpendicular distance of said first groove part from the plane defined by said joining surface is unequal to the perpendicular distance of said third groove part from the plane defined by said joining surface, and said fourth groove part being located on the same side as said second groove part in such a manner that the perpendicular distance of said second groove part from the plane defined by said joining surface is unequal to the perpendicular distance of said fourth groove part from the plane defined by said joining surface.

9. The attachment means of claim 4, **characterized** in that said locking groove (26) or groove part comprises a locking hollow (27) which in the cross section of the attachment means is shaped like J in such a manner that the stem of the J is perpendicular to the projection of said joining surface, the curving end of the J points away from the projection of said joining surface and the point of the curving end of the J points away from the centre axis of the cross section of the attachment means, said centre axis being perpendicular to the projection of said joining surface.

10. The attachment means of claim 3, **characterized** in that said preformed point of attachment is an attachment protrusion (21) for creating a mechanical attachment between said attachment means and said component when said attachment protrusion and a corresponding locking groove (22) in said component are placed against one another.

11. The attachment means of claim 1, **characterized** in that it has an elliptic cross section.

12. The attachment means of claim 1, **characterized** in that it has a hexagonal cross section.

13. An EMC shield (18) attached to a printed circuit board, comprising a planar cover and as part of it, at least one side wall (19), **characterized** in that said side wall is made elastic and comprises a preformed point of attachment (20; 22; 25) for creating a mechanical attachment between said EMC shield and attachment means fixed to the printed circuit board when said point of attachment and a corresponding preformed point (16; 21; 26) in said attachment means are placed against one another in a position which causes an elastic deformation in said side wall and thus

a spring force pushing said point of attachment and said attachment means against each other.

14. The EMC shield of claim 13, **characterized** in that said point of attachment is an attachment protrusion (20; 25) for creating a mechanical attachment between said attachment means and said EMC shield when said attachment protrusion and a corresponding locking groove in said attachment means are placed against each other.

15. The EMC shield of claim 14, **characterized** in that said side wall comprises a first branch (19a; 24) and a second branch (19b; 24), both branches comprising an attachment protrusion so that the attachment protrusion of said first branch points towards said second branch and the attachment protrusion of said second branch points towards said first branch to create a mechanical attachment between said attachment means and said EMC shield when said first branch and second branch are placed on the opposite sides of said attachment means.

16. The EMC shield of claim 15, **characterized** in that at least one branch of said side wall further comprises, as part of said attachment protrusion, a locking tongue (25) which points substantially away from the direction which is the intended main direction of the mounting movement of said EMC shield when the EMC shield is being installed to the printed circuit board by means of said attachment means.

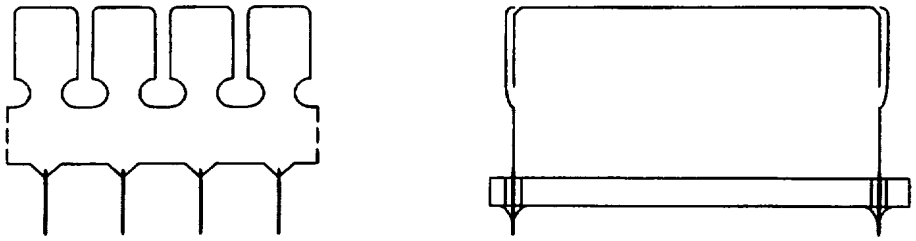

Fig. 1
PRIOR ART

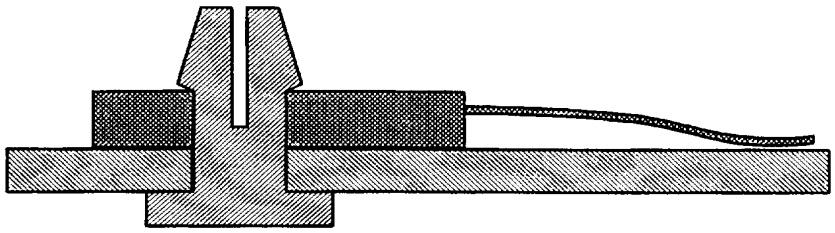

Fig. 2
PRIOR ART

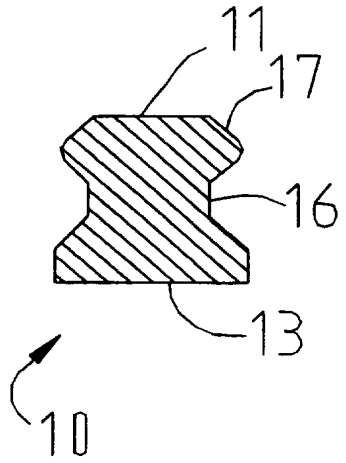

Fig. 3a

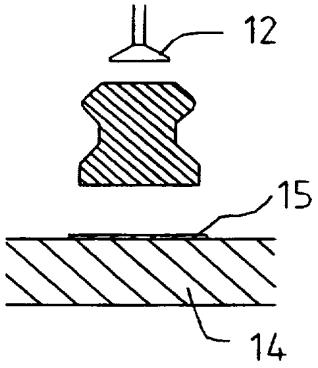

Fig. 3b

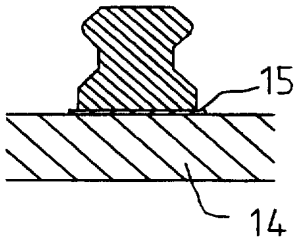

Fig. 3c

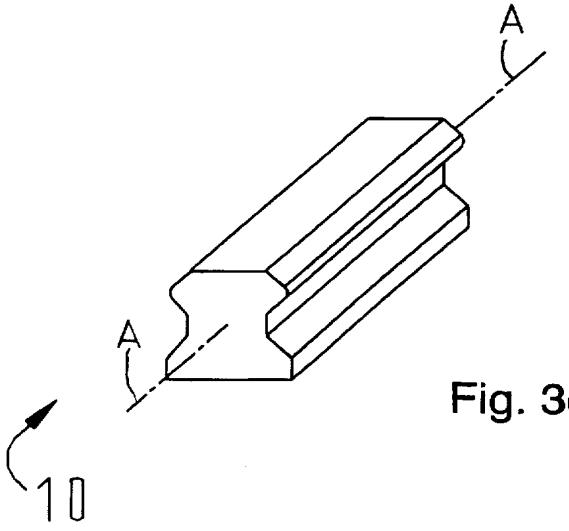

Fig. 3d

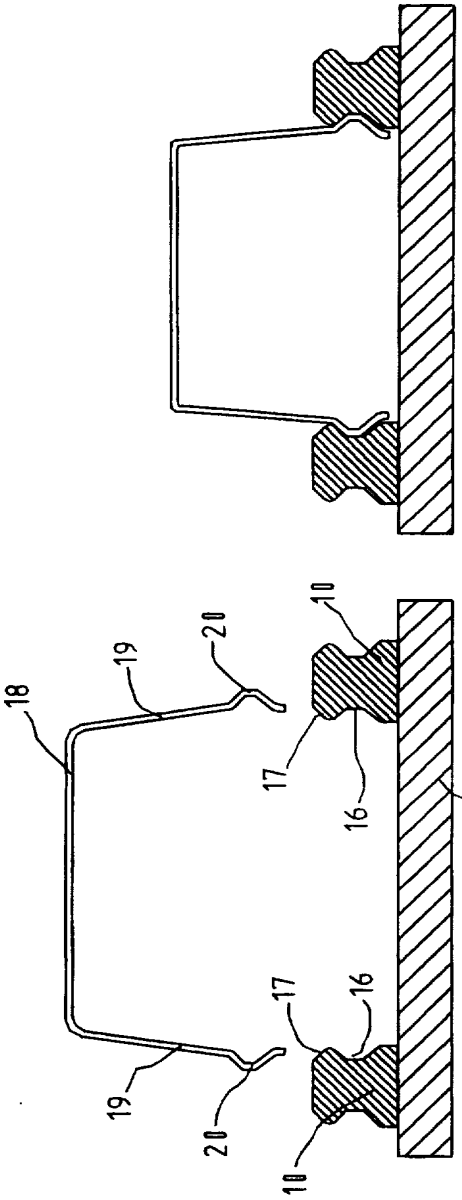

Fig. 4a

Fig. 4b

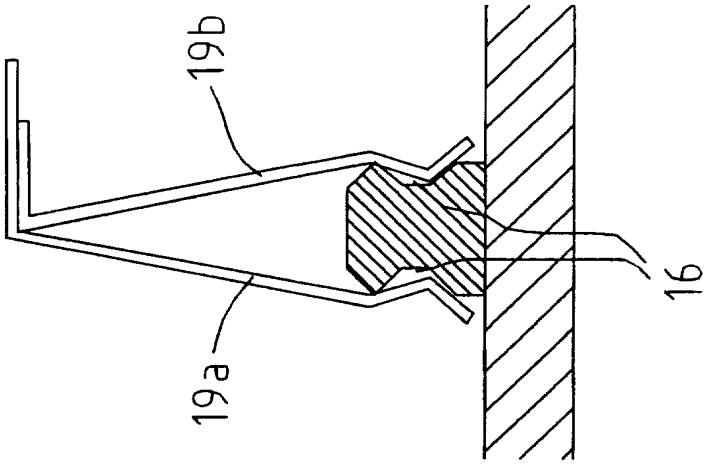

Fig. 5b

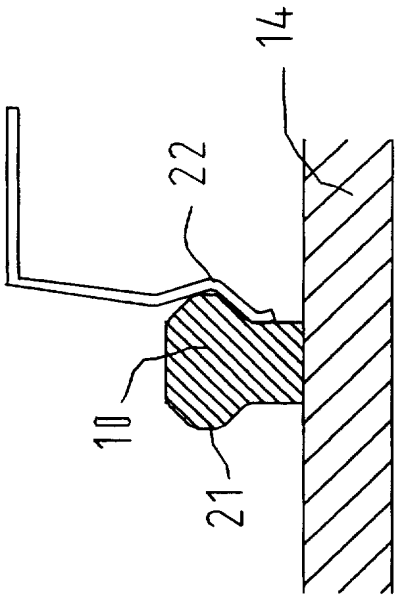

Fig. 5a

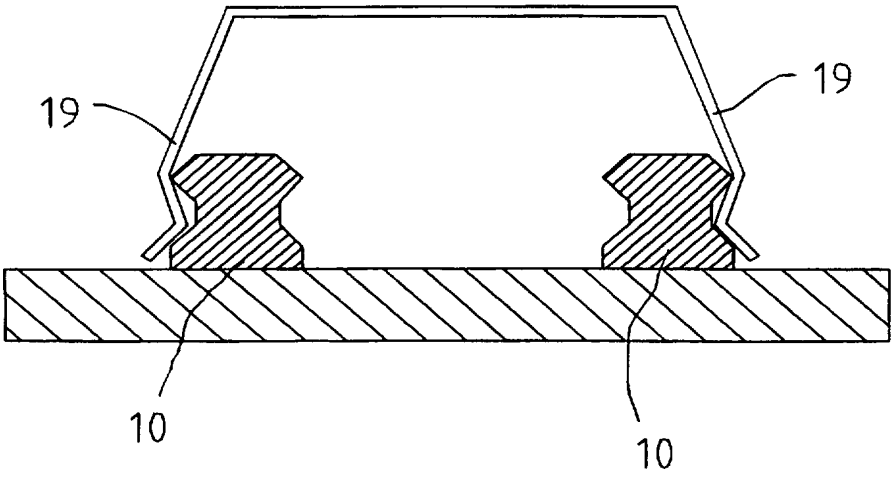

Fig. 5c

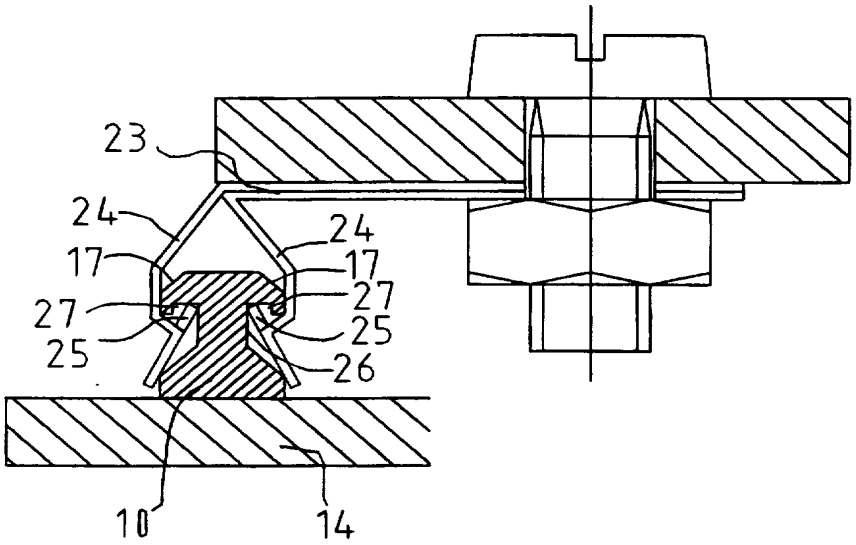

Fig. 5d

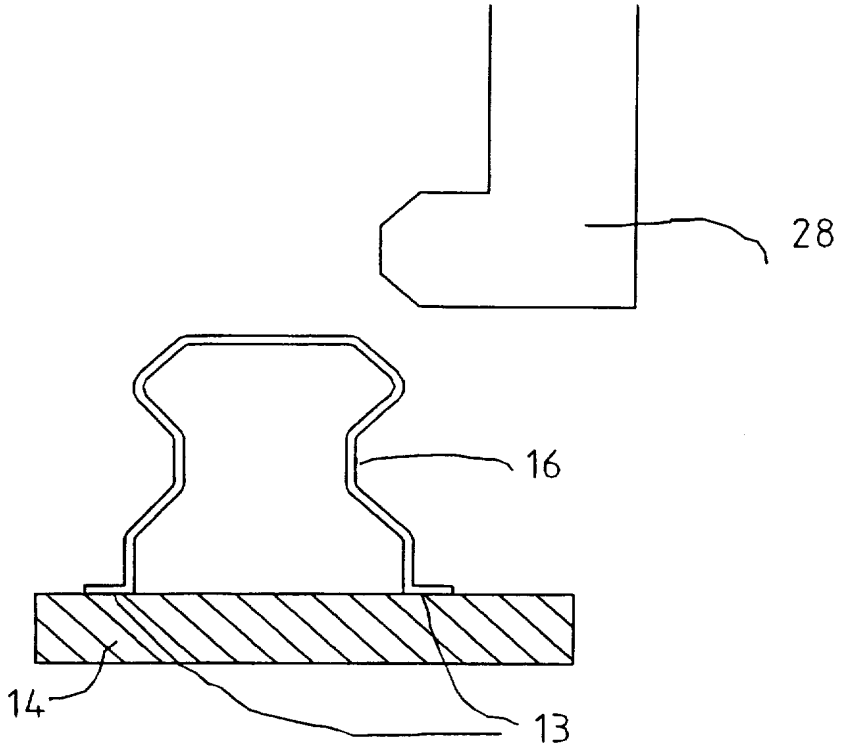

Fig. 5e

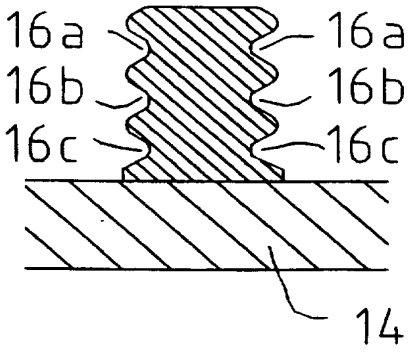

Fig. 5f

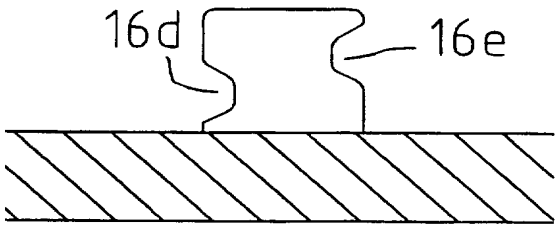

Fig. 5g

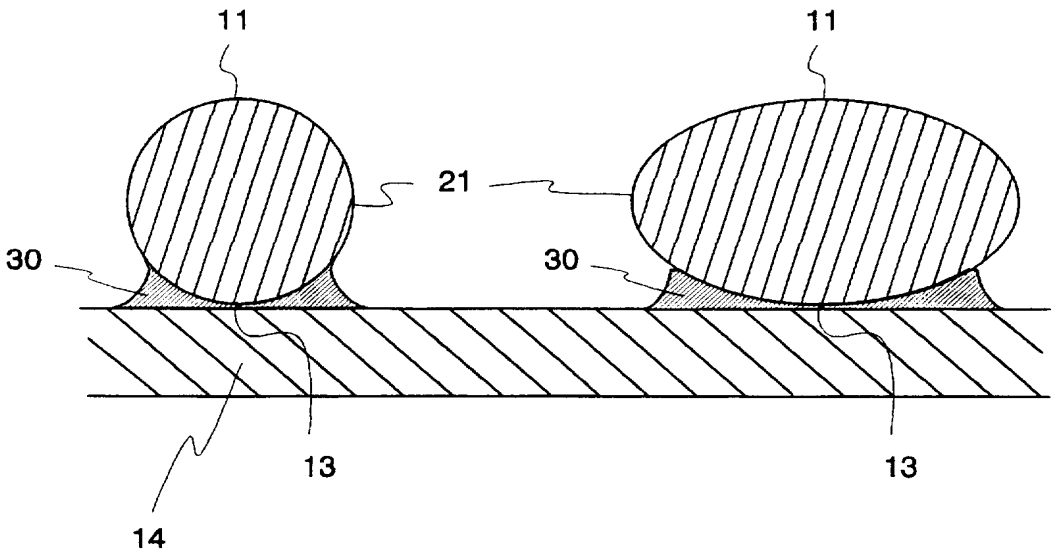

Fig. 5h

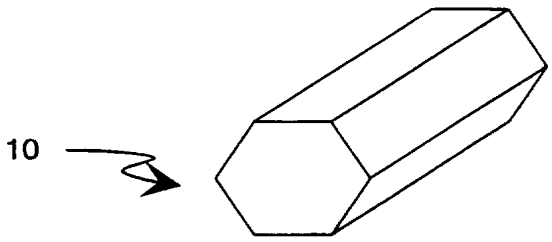

Fig. 5i

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00248

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H05K 9/00, H01R 13/648
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H05K, H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9419874 A1 (MOTOROLA, INC.), 1 Sept 1994 (01.09.94), page 3, line 30 - page 4, line 6 --	1,13
X	US 5354951 A (W.A. LANGE, SR. ET AL.), 11 October 1994 (11.10.94), column 4, line 50 - line 60 --	1,13
X	US 5353201 A (O. MAEDA), 4 October 1994 (04.10.94), column 2, line 27 - line 33 --	1,13
X	US 5014160 A (J.F. MCCOY, JR), 7 May 1991 (07.05.91), figure 3 --	1,13

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 Sept 1997	26 -09- 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Sven-Olof Wirlée Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00248

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4754101 A (W.H. STICKNEY ET AL.), 28 June 1988 (28.06.88), figures 1-11, abstract --	1,13
A	US 4890199 A (S.D. BEUTLER), 26 December 1989 (26.12.89), figures 3-4 --	1,13
A	WO 9528074 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 19 October 1995 (19.10.95), figures 1-5, abstract --	1,13
A	US 5506374 A (Y. KAWAKAMI), 9 April 1996 (09.04.96), figures 1-2, abstract -- --------	1,13

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/09/97

International application No.
PCT/FI 97/00248

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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PUB-NO: WO009741716A1
DOCUMENT-IDENTIFIER: WO 9741716 A1

TITLE: SURFACE-MOUNTED ATTACHMENT MEANS AND USE THEREOF

PUBN-DATE: November 6, 1997

INVENTOR-INFORMATION:

NAME	COUNTRY
KAUHANIEMI, JARI	FI
KAUHANIEMI, PETRI	FI

ASSIGNEE-INFORMATION:

NAME	COUNTRY
KAUHANIEMI JARI	FI
KAUHANIEMI PETRI	FI

APPL-NO: FI09700248
APPL-DATE: April 25, 1997

PRIORITY-DATA: FI00961798A (April 26, 1996)

INT-CL (IPC): H05K009/00 , H01R013/648

EUR-CL (EPC): H01R013/648 , H01R023/70 , H01R023/70 , H01R023/70 , H05K003/40 , H05K009/00

ABSTRACT:

CHG DATE=19990617 STATUS=O>A surface-mounted attachment means (10) having a contact part (11) for the seizing head of an insertion machine for surface-mounted components, a joining surface (13) for attachment to a printed circuit board, and a preformed point of attachment, which may be a groove (16; 26) or protrusion (21), is used for attaching an EMC shield (18) and other mechanical components to a printed circuit board (14) and for attaching the printed circuit board to other mechanical parts. The EMC shield has an elastic side wall (19) and, therein, a corresponding preformed part (20) which, during installation, is pushed by a spring force caused by the elastic side wall against a locking groove or protrusion in the attachment means and holds the EMC shield in its place. Other mechanical attachments (23), too, can be implemented by means of a similar attachment means.